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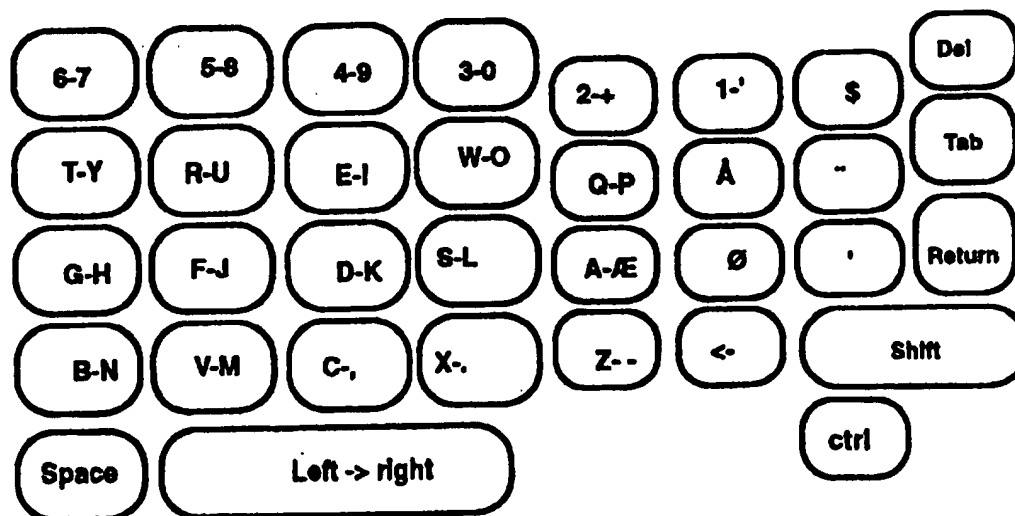
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(54) Title: KEYBOARD FOR ONE HAND TYPING



**(57) Abstract**

Characters, etc. are assigned to the keys of the keyboard in direct relationship to the physical positions of corresponding keys on the Sholes (QWERTY) keyboard. One embodiment is a chorded keyboard taking up very little space. A second embodiment can be used without training. Touch typing on this will be slower than on a Sholes keyboard, but significantly faster than hand writing or typing on Sholes keyboard with reduced size keys or any non-standard keyboard. The keyboard can be incorporated into equipment considerably smaller than known lap-top computers. With keys of sizes recommended for Sholes keyboards, the second embodiment can be made down to 13x6 cm, providing pocket computers or similar incorporating the new keyboard, of a size approx. 14x7x3 cm. Such device can be a portable computer terminal, a communication terminal or part of a dual mode device, the keyboard being used for entry of alphanumeric characters and in another mode for controlling the communication facilities. Tests indicate that it is possible to switch between using the Sholes keyboard and the new keyboard without any confusion or delearning of touch typing on either keyboard.

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## KEYBOARD FOR ONE HAND TYPING

## TECHNICAL FIELD

The invention relates to electronic keyboards for one-hand operation, of the type mentioned in the preamble of claim 1.

## 5 DEFINITIONS OF TERMS

In this document the word 'keyboard' means equipment for the entry of alphanumeric data as well as commands, instructions, etc., or for any data entry using a similar principle, for instance the playing of music. The word 'keyboard' means  
10 both the actual hardware and any software used for operating it, also if such hardware or software is situated in separate equipment connected to the physical keyboard.

The word 'keypad' designates the area of the keyboard occupied by the keys.

15 The word 'key' means an element or area on the keypad that registers if it is pressed, released, manipulated, touched or otherwise activated by the user. Such registration by the key can be done through the closing of an electrical switch or through other suitable sort of sensing or scanning device.

20 The term 'chorded keyboard' means a keyboard where generally all characters are obtained by simultaneous activation of more than one key (like when striking a chord on a piano keyboard).

The term 'transmission of a character' designates the  
25 event when a number of actions done by the user on the keyboard results in one or more alphanumeric characters being transferred to some sort of memory or other receiving device in the keyboard or in a piece of equipment connected to it.

The term 'Sholes keyboard' means the current, almost  
30 universally used 'QWERTY' keyboard layout (designed by Christopher Latham Sholes (US) in 1868), including national editions or adaptations thereof, such as 'QWERTZ' (Germany and some East European countries) or 'AZERTY' (Belgium and France).

35 The terms 'right hand portion' and 'left hand portion' of the Sholes keyboard, means the two portions of the Sholes keyboard intended for use with the right or the left hand of the user, respectively, when touch typing, the portions being

e.g. divided between the keys 5-T-G-B and 6-Y-H-N or divided between the keys 6-Y-G-B and 7-Y-H-B (B and Y in the latter case being activated with either hand).

#### BACKGROUND OF THE INVENTION

5 A keyboard of the type mentioned by way of introduction is disclosed in US-A-5,087,910. This keyboard being of the chorded type, it comprises a five-state key for the thumb and three-state keys for the fingers other than the thumb. In practice, the five-state key may consist of four separate  
10 keys, none or one of these being depressed, giving five different states, and the three-state keys similarly consisting of two separate keys. The keys are laid out according to positions of rest of the fingers, thus minimising the movements needed of the fingers when typing.

15 Other keyboards with reduced number of keys are disclosed in GB-A-2,071,578; DE-A-21 65 190; and WO 89/2369.

Another keyboard of the above mentioned type is disclosed in US-A-5,336,002. This keyboard essentially comprises four rows of keys and has a general construction of the same type  
20 as the Sholes Keyboard, being considerably narrower than this owing to the keys generally being assigned two characters each. It can be made using similar components as for the Sholes keyboard. However, it utilises a layout of the characters quite different from the Sholes layout, thereby requiring vast  
25 re-training of persons using the Sholes keyboard and - as will be explained below - conflicting with the user's alternating use of the Sholes keyboard.

The so-called Dvorak keyboard developed by August Dvorak and his colleagues in the 1930's is the only serious attempt  
30 on replacing the Sholes keyboard with another. The attempt failed for several reasons:

- A number of mistakes were made when the Dvorak keyboard first was marketed, resulting in a very poor reception by the general public.
- 35 - The user must spend a very considerable period of time on retraining before he gets any advantage from the use of the Dvorak keyboard, and newer results indicate that the typing speed on the Dvorak keyboard is only 5% faster than the typing speed on the Sholes keyboard.

- When the user has trained the use of the Dvorak keyboard it is very difficult to return to using the Sholes keyboard; an individual or an organisation cannot move gradually from use of the Sholes keyboard to use of the Dvorak keyboard; the decision must be made once and for all. This in fact applies to all keyboards having a physical similarity with the Sholes keyboard together with a different layout of the characters.

It is amazing that the Dvorak keyboard, in spite of the points above, is still discussed, but since it offers only a very limited advantage in comparison with the Sholes keyboard, its introduction is extremely unlikely.

However, during the last 10 years changes in the use of electronic equipment has created a market for alternatives to the Sholes keyboard:

- Today the entire work process and not only the typing of a manuscript is often done using a computer. It is therefore often necessary for the user to use one hand while typing, for instance for consulting literature, using a telephone or drawing or manipulating elements on the computer screen. In such cases it is advantageous if the user can enter alphanumeric characters by touch typing with only one hand.
- A portable computer for touch typing is equipped with a Sholes keyboard of normal size; the width of the computer will therefore normally be at least 22 cm. The computer can be portable, but it will not fit into a pocket.
- When using a portable computer outside an office environment it will often be advantageous to hold the computer with one hand, while entering alphanumeric characters with the other.

The following three types of data entry are used today for entering alphanumeric characters with one hand or for entry of alphanumeric characters, where a normal Sholes keyboard is too large. These devices may all be designed with a total width that is approx. half of the width of a computer with the Sholes keyboard. However, they all suffer from serious disadvantages:

- 1) Pen-based solutions: The 'Newton' computer from Apple® is the most advanced example of a computer where alphanumeric

characters are written directly on the screen with a pen. Despite a very large developmental effort it has still only a very limited ability for recognising hand-written characters. Even with a function for recognising whole words, experiments  
5 have shown that it still misreads approx. one word in five, and the result is far worse when it does not have a built in dictionary for the language being used.

2) Current chorded keyboards, where some of the characters are entered by the simultaneous pressing of more than one key:  
10 A number of chorded keyboards has been proposed, but none of them have gained any acceptance; while a Sholes keyboard can be used without any training at all, it is only possible to use a chorded keyboard after some training. The user must therefore spend a considerable amount of time training before  
15 he can start using a chorded keyboard.

3) Keyboards where the surface area of each key is reduced: When the keys are smaller, they will always be more difficult to hit; according to Fitt's law there will always be an inverse relationship between how easy it is to hit a key  
20 and the size of it. Typing on a keyboard with keys of a reduced size are therefore slower than typing on the normal Sholes keyboard, and touch typing becomes in particular impossible when the user must hit keys that are smaller than 12 mm in diameter.

25 The keys are in some cases placed in a configuration that is different from the Sholes keyboard, for instance in alphabetical order. It is extremely unlikely that any person will learn touch typing on such a non-standard set of keys. This means that the typing speed always will be far slower than  
30 touch typing on a Sholes keyboard.

#### SUMMARY OF THE INVENTION

In order to overcome the problems presented by the earlier solutions, the invention seeks to provide a keyboard for one-hand operation, permitting:

- 35 - A data terminal for touch typing being made down to a size of less than 8 x 3 x 15 cm.  
- A communication device for use either as a cellular telephone or other communication device, or as a small data

terminal where alphanumeric characters can be entered through touch typing.

- A one-hand keyboard integrated in the current Sholes or QWERTY keyboard, so that touch typing with one hand temporarily is possible.

The invention seeks to fulfil the following requirements:

- It shall be possible to do touch typing with one hand on the keyboard according to the invention.

- The width of the keyboard shall be smaller than the width of the Sholes keyboard; the width of the keyboard according to the invention shall ideally be less than half the width of the Sholes keyboard.

- Users who have learned touch typing on the Sholes keyboard shall be capable of touch typing on the keyboard according to the invention, with little or no training.

- Use of the keyboard according to the invention must not reduce the user's capability of touch typing on the Sholes keyboard.

- The Sholes keyboard is made for the mechanical design for typewriters used before the invention of electric typewriters. It is therefore possible to improve that design in a number of ways, yielding better ergonomical features.

These objectives are being met by implementing the provisions stated in the characterizing portion of claim 1.

- By assigning characters to the keys of the keyboard in a mnemonically simple relationship to the positioning of the characters on the Sholes keyboard, it will be far easier for the user to apply previous learned habits of touch typing on the Sholes keyboard to touch typing on the keyboard of the invention. It has been shown (Yamada, Hisao in Certain Problems Associated with the Design of Input Keyboards for Japanese Writing, in Cognitive aspects of skilled typewriting, ed. by William E. Cooper, Springer-Verlag, USA 1983) that a typist's knowledge of touch typing primarily and ideally is spatial and not verbal. It is therefore easy for the user to associate from the way the character is activated on the Sholes keyboard to the way it is activated on the keyboard according to the invention.

- By the provisions stated in claim 2 there is achieved a particularly simple and reliable relationship between the

assignment of characters to the keys of the new keyboard and the positioning of the characters on the Sholes keyboard.

A first embodiment of the invention as a chorded keyboard is described in dependent claims 3-8. The keyboard is in this  
5 embodiment particularly compact and of simple construction; by the provisions of claim 8 it can be made for use with either hand. The keyboard of the first embodiment is ergonomically well adapted to the hand.

A second embodiment of the invention as a non-chorded  
10 keyboard is described in dependent claims 9-18. The keyboard is in this embodiment resembling the Sholes keyboard to a relatively high degree, thereby effectively supporting the mnemonic relationship of the user to the Sholes keyboard.

The provisions described in claims 7, 11 and 13 assures  
15 that the user do not need to depress a specific combination of keys at the very same time, the transmission of a character being activated by special sequences where some of the keys can be activated in any order.

It is in general very difficult to make a complex movement  
20 involving several fingers at the same moment (Rosenbaum, David A., Kenny, Sandra M. & Derr, Marcia A.: Hierarchical control of rapid movement sequences, in Journal of Experimental Psychology, 1983, vol. 9, No. 1, pp. 86-102); the way persons structure their movements indicates that the movements of  
25 different fingers is to some degree interdependent. It is therefore advantageous if the fingers can be given more freedom of movement by making it unnecessary for the user to make all the movements necessary for activating the transmission of one character at the same moment or in a pre-defined order.

### 30 THE DRAWINGS

In order to explain the invention in more detail, hereinafter will be described embodiments thereof, by way of example only and with reference to the drawings, in which:

Fig. 1 by way of reference shows the prior art Sholes  
35 keyboard layout with indications of the areas of the keypad intended for each of the user's fingers for touch typing, and two lines, each dividing the keyboard in a left hand portion and a right hand portion,



Fig. 2 schematically shows a chorded keyboard for one-hand operation, according to a first embodiment of the invention,

Fig. 3 shows the keyboard in Fig. 1 with the hand of the operator in place,

5 Fig. 4 schematically shows the principles of coding of the keyboard in Fig. 1,

Fig. 5 schematically shows a non-chorded keyboard for one-hand operation, according to a second embodiment of the invention, in USA layout for right-hand use,

10 Fig. 6 schematically shows a USA layout for a keyboard of same type as in Fig. 4, for left-hand use,

Fig. 7 schematically shows a Danish layout for a keyboard of same type as in Fig. 4, and

15 Fig. 8 schematically shows a Danish layout for a keyboard of same type as in Fig. 5.

#### PRIOR ART

Fig. 1 shows the well known Sholes keyboard layout, as well as lines dividing the portions intended for use by each hand and each finger, respectively, when touch typing. Note  
20 that two lines 100, 101 are shown dividing between the two hands, thus indicating two ways of making this division.

#### DETAILED DESCRIPTION OF ONE EMBODIMENT

According to a first embodiment of the invention, the keyboard is made as a chorded keyboard, but incorporates coding principles and sequences as earlier described. Reference  
25 is made to Figs. 2-3, in which the shape of the keyboard is shown only schematically, and to Fig. 4.

A keyboard 1 is equipped with two, three or four keys 2-13 for each finger on the user's hand. The number of possible  
30 combinations is higher than the number of lower and upper case letters and special characters on a conventional keyboard, and it is therefore possible to avoid using any combinations of keys that might be difficult for a user to activate.

Combinations of keys are used to activate the transmission  
35 of a character from the keyboard. It is possible to apply a mnemonic coding principle with a uniform relation from each such combination of keys to the positions of the corresponding keys on the Sholes keyboard, as described earlier. Fig. 4

shows how these principles can be realized. The symbols in each key position corresponding to the Sholes keyboard show the actions the user must do for activating the associated character.

5        In the embodiment described, the coding follows these rules:

- 10        - Depending on the row 20-23 in which the key for the desired character is situated on the Sholes keyboard, the ring finger shall either press the key 10 or the key 11 or none at all.
- 15        - Depending on the character to be transmitted being located either on the right hand portion 24 (dark shade in Fig. 4) or the left hand portion 25 (light shade) of the selected row 20-23, the little finger shall either press no or one, respectively, of the keys 12-13. Either key 12, 13 may be used at the user's discretion, as experience shows that many users are in limited control of the little finger.
- 20        - Depending on the horizontal position of the character on the relevant portion 24, 25 of row 20-23, index and middle fingers shall press the keys 6-9 in a pattern which is uniform for all said portions of rows of the keyboard; for instance the combination of keys used for activating the second character in one segment of the keyboard (i.e. 2, 8, W, I, S, K, Z, M) will always be the same no matter the particular portion and row, respectively (in this case key 7 activated and keys 6, 8, 9 not activated). Such a pattern of keys can be made symmetrical or cyclical in order to make it easier to learn.
- 25        - The thumb is used for choosing between lower and upper case letters, numbers and function keys.
- 30        Details could be as follows:
  - 35        - A timer is reset and started each time a key is activated, and the value of the key is added to the parameter set defining the resulting character. The character is then transmitted when the timer runs out, that is when the same combination of keys has been activated for a pre-defined period of time.
  - 40        - One unit is added to a counter or a similar device every time a key is activated and the value of the key is added to the parameter set defining the resulting character.

Every time the activation of a key stops, one is subtracted from the counter or similar and the parameter associated with the key removed from the parameter set defining the resulting character. The character is transmitted when the number of keys activated is decreased, and the character to be transmitted is determined by the parameter set just before reduction of the number of activated keys. This sequence may in addition include a timer, introducing a sort of hysteresis, so the character only is transmitted a short period after the number of keys activated has been reduced and only if no further keys has been activated.

In order to eliminate the need for moving two fingers at exactly the same time it is necessary to describe a flexible sequence for activating the transmission of a character. In this embodiment of the keyboard of the invention, it is preferred to equip one or more keys, e.g. the selector keys 10-13 and the shift key 2, with a lock function which is released after a character has been transmitted. In this way, it is not necessary to keep the selector keys depressed while the remaining part of the sequence is entered. It is then possible for instance to set the keyboard to upper case letters before the remaining part of the sequence defining the character is effected.

It is in addition possible to define one or more 'empty' sets of keys where no character is transmitted when the number of keys activated is reduced: if for instance the simultaneous pressing of five keys results in no character being transmitted after one of the keys is released, it is always possible for the user to escape without entering any character.

To the keyboard 1 can be added a display or window showing the character equalling the parameters entered by pressing the keys, or the portion of the row of the Sholes keyboard given by the parameters entered.

In this embodiment, the thumb is used for changing between lower and upper case letters with a shift key 2 and activating of function keys or editing functions such as 'Tabulator', 'Cut', 'Copy', 'Open' or 'Close' functions using keys 1, 3, 4. It is possible to provide a 'Lock' function similar to 'Shift lock' on a Sholes keyboard.

It is possible to adapt this keyboard so that it can be used with either right or left hand, for instance by duplicating the keys 2-5 for the thumb, on the opposite side 14 of the keyboard (not visible in Fig. 2), and at the same time re-defining the keys 6-13 to a lateral reversed mode of operation; or by turning the entire keyboard upside down so that the upper side 15 becomes the bottom side, and likewise re-defining the keys 2-13 appropriately.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

According to a second embodiment of the invention, the keyboard is made as a non-chorded keyboard, incorporating coding principles and sequences as earlier described. Reference is made to Fig. 5, in which the layout of the keypad for right hand use in USA is shown schematically.

The second embodiment is based on the existing Sholes keyboard, and can be made using similar components as for the Sholes keyboard. The embodiment can be used without previous training of typing, and users who have learned touch typing on a Sholes keyboard can immediately start touch typing on it.

The second embodiment utilises the relations between the movement of the fingers on one hand and the movement of the fingers on the other hand. It is shown, that when persons perform a movement with the fingers on one hand it is very easy at the same time to perform a similar but mirrored movement with the fingers on the other hand (Munhall, Kevin G. and Ostry, David J.: Mirror-image Movements in Typing, in Cognitive aspects of skilled typewriting, ed. by William E. Cooper, Springer-Verlag, USA 1983).

The keyboard according to the second embodiment essentially comprises four rows 30-33 of keys and resembles either the left hand or right hand portion of the Sholes keyboard; in Fig. 5: the right hand portion.

There are a few special keys whose function will be described later. The other keys 39 are assigned two different characters each:

- The second character 36 (Y, U, I, O, P, etc.) is the one associated with the same position of key on the right hand portion of the Sholes keyboard.

- The first character 35 (T, R, E, W, Q, etc.) is the one associated with the similar but laterally reversed position of key on the Sholes keyboard, i.e. the character in the same row, to be stroken with the corresponding finger on the left hand of the user.

It is thus possible to transmit one of two different characters 35, 36 from each character key 39 on the keyboard.

Examples of other layouts of the keys on the keyboard according to the second embodiment of the invention are shown in Figs. 6-8, as mentioned in the list of drawings.

The following elements are used in the sequence of transmitting a character from the keyboard:

- A left-right selector key 34 is used for selecting one of the two said characters associated with any one key. Since the most often used characters are situated on the left hand portion of the Sholes keyboard, it is advantageous if the character 36 associated with the left hand portion is transmitted when the left-right selector key 34 is not pressed.
- 'Shift' and 'Control' keys 37, 38 are used for the activation of upper case letters, selection of control characters and similar functions.
- If one of said keys 34, 37, 38 are pressed, a parameter will be set to reflect that change and the parameter will remain set until either the same key is pressed once more, one of the keys associated with two characters is pressed, or a time-out occurs. The state of the keyboard will then return to standby. Thus, these keys stay activated after actually being released by the user, thereby eliminating need to move any two fingers at the same time and in particular to press a specific set of keys at exactly the same time. Alternatively, these keys may be made to function in the same way as with the known Sholes keyboard used for Personal Computers.
- Finally, a character key 39 associated to two characters 35, 36 as described above is activated, and the selected character 35 or 36 is transmitted from the keyboard.

The left-right selector key may be laid out to be operated by the thumb, by another part of the hand, for instance the palm of the hand, or any other finger than the thumb.

If for instance the user wants to enter the character 'J' (upper case), which is situated on the right hand portion of the Sholes keyboard, he can do that by activating:

- The left-right selector key 34 and the 'Shift' key 37. These keys may be activated in any order.
- The key showing the letters 'F-J', these letters being assigned to the same key.

If the user before choosing the letter 'j' wants to change the letter back to a lower case 'j', he can do that by once more pressing the 'Shift' key 37 in order to cancel the first depression of this key.

Alternatively, into this sequence can be incorporated other types of functions replacing the function of the left-right selector key, such as:

- Use of keys with some sort of mechanical 'toggle' function. Such a key would transmit one signal when the user bends his finger and another when he pushes with it.
- Use of a timer: if the key is pressed for a short period of time, one character is transmitted, if the key is pressed for a longer period of time, another character is transmitted.
- Use of sensitivity to 'double clicks'; striking a key two times very quickly activates the other character.

The earlier described geometry of the keyboard can be applied. In addition the following geometrical features can be added depending on the application:

- The columns of keys can be placed regularly at an angle of 90° with the rows of keys instead of irregularly, at a sloping angle as on the Sholes keyboard; this will reduce the risk of the movement of one finger being blocked by another.
- In order to minimise any need for changing the direction of the fingers during the operation and to minimise any conflicts between movements of different fingers, the keys operated with one finger during touch typing can be placed on a line parallel with the finger used for operating them. The keys can then either be placed on parallel lines

or along lines that meet on the side of the keyboard according to the invention where the user is situated during use, like in a polar coordinate grid.

- 5       - The radius of the curve in which the keyboard rises and the size of the keys can be made smaller for the keys operated by the little finger than for the keys operated by the other fingers, as shown in Figs. 5-8, and the keys to be activated by the thumb can be placed in a circle along the path of movement of the palm of the thumb  
10       instead of on a straight line parallel with the normal position of the thumb.
- 15       - Either the 'space' key 40 or the left-right selector key 34 can be placed inside the natural curvature of the fingers, so that it can be operated with either ring, middle or index fingers.

With the second embodiment, in particular, it is possible to use a pointing 'pad' as input device for the left-right selector signal. Such a pad can in addition be operated with minimal force reducing fatigue of the user.

- 20       It is possible to combine the second embodiment of the invention with other electronic equipment:

- 25       - The functions of this second embodiment can be incorporated in a portion of a normal Sholes keyboard. The result will be a keyboard that can be used as a normal keyboard and where it is possible for the user for a period of time to type with one hand when the other hand is used for instance for holding a telephone handset or handling papers.
- 30       - A function key can be used for changing the mode of the keyboard to a mode similar to a numeric keypad with the optional inclusion of one top row that is used as 'soft keys' where the actual function activated by each key is shown in a display above. It is thus possible to make a device that can be used both with a numeric keypad for  
35       instance as a cellular phone or another communication device and as a device that is operated through an alphanumeric keyboard.

## E X A M P L E

A preliminary test has been made of a prototype of the second embodiment of the present invention. The prototype was through an interface connected to a computer and could be used  
5 for entering alphanumeric characters to standard applications.

The prototype had, however, a number of limitations:

Even though the keys used for selecting a pair of characters were spaced with a centre to centre distance on 18 mm, the active width of each key was only 12 mm.

10 The keys used for selecting a pair of characters were made of rubber with a characteristic of movement that was significantly worse than on a normal keyboard; a force of 150 g was necessary for activating a characters key as opposed to less than 60 g on a good quality standard keyboard.

15 The key used for choosing between the left and the right hand portion of the Sholes keyboard needed a rather large force of 400 g to be activated, and needed to be kept depressed during the entering of the relevant character.

The 'Space' key was located at a corner and could only be  
20 pressed with the little finger; it should preferably be pressed with the thumb.

There was no 'Shift' function in the prototype.

The speed touch typing after a manuscript on a normal Sholes keyboard was measured to 190 chars/min for the test  
25 person.

The speed of touch typing on a Sholes keyboard with similar characteristics as the prototype would, however, only be approx. 63% of the speed on a normal keyboard, or calculated from the data gained during the testing approx. 120 chars/min.

30 The test consisted of typing of 10 sequences of 3 min touch typing from a manuscript with a break after each sequence.

The speed rose during these sequences from a typing speed of 31 chars/min to 38 chars/min. The typing speed increased in  
35 other words 21% during the typing of approx. 1,000 characters.



## TEST RESULTS

	Sequence No.	Characters typed	Chars/min
	1	94	31
	2	94	31
5	3	106	35
	4	99	33
	5	94	31
	6	105	35
	7	106	35
10	8	117	39
	9	113	38
	10	114	38

The test was interrupted by two longer breaks with approx. duration of half an hour after the 5th period of typing and after the 8th period of typing. The typing speed showed a significant increase after each break indicating that some of the training was offset by fatigue due to the difficult physical characteristics of the prototype. A considerable fatigue in the fingers was experienced already after 3 minutes of typing and a test with another person had to be interrupted after a few minutes due to fatigue and the difficult characteristics of the prototype.

This means that the speed of typing on the prototype during the typing of the first 1,000 characters equals an increase in speed from 26 to 32% of the typing speed on a similar Sholes keyboard. The actual increase in speed may however have been slightly higher since some fatigue was noted during the last interval of typing.

## SUMMARY

Two embodiments of a keyboard for touch typing with one hand are disclosed, being easy to operate for persons that already has learned to use a Sholes keyboard.

The first embodiment can be used after some training.

The second embodiment can be used immediately, in particular by users who already have learned touch typing on a Sholes keyboard. It is likely that such a keyboard will be accepted, not as a replacement for the Sholes keyboard, but as an alternative that can be used where typing with one hand or a smaller keyboard is desirable.

Tests of a prototype of the second embodiment has shown that it is possible for a person who has learned touch typing on a Sholes keyboard to start doing touch typing on the keyboard according to the second embodiment of the invention  
5 after a very short introduction.

It will be obvious to the person skilled in the art that a suitable type of learning program could be incorporated in the keyboard; although it is possible to start using the keyboard according to the invention without this aid, it will make the  
10 start easier for the user.

The prototype was developed for operation with the right hand. However, it is likely that the left hand is more closely related to spatial and non-verbal skills than the right hand. For that reason it may interfere less with other tasks if the  
15 touch typing is done with the left hand. In addition, the user is even while using touch typing to some extent dependent on using visual guidance for finding keys. Since approx. 57% of the touch typing is done with the left hand on the Sholes keyboard, the average use of the visual guidance will be  
20 improved if the keyboard is made for use with the left rather than the right hand. It is therefore likely that a left handed version of the keyboard according to the invention is preferable.

A special question is the typing speed on the keyboard  
25 according to the invention. If the change in speed is calculated from the number of times keys shall be activated on the keyboard according to the invention in order to type the text, the typing speed when touch typing on the keyboard according to the invention will be 70% of the typing speed when touch  
30 typing on the Sholes keyboard. However, during touch typing the movement of one finger will whenever possible start before the preceding character has been typed. When the typing is done with only one hand, the start of some of the movements is therefore slightly delayed; when this is taken into consideration the typing speed on the keyboard according to the in-  
35 vention can be between 60 and 70% of the typing speed on a Sholes keyboard.

## C L A I M S

1. An electronic keyboard for one-hand operation, more particularly for the input of alphanumeric characters and/or processing instructions, etc., the keyboard comprising a plurality of keys and an electronic circuit electrically connected to said keys to interpret the state of the keys and to deliver a signal indicative thereof, said electronic circuit also having external connection and transmittal means, the keys being arranged in such a way that they may be activated without the user repositioning the palm of the hand, and the electronic circuit being so arranged that a first group of characters is obtainable when a predetermined key is activated and a second group of characters is obtainable when said predetermined key is not activated, c h a r a c t e r i z e d in that the characters of the first and second groups are assigned to keys or combinations of keys generally in dependence of the position of the keys assigned the same characters on the Sholes keyboard layout (the "QWERTY" layout), whereby a mnemonically simple relationship is obtained between the assignment of a character to a key or a combination of keys on the keyboard and the position on the Sholes keyboard layout of the key assigned the same character.

2. A keyboard according to claim 1, c h a r a c t e r i z e d in that the characters of the first and the second groups, respectively, comprises characters from the right hand or the left hand portion of the Sholes keyboard layout, as divided between the two hands of a user for touch typing.

3. A chorded keyboard according to claim 1 or 2, the keys being arranged in such a way that they can be activated substantially without the user altering the direction of the fingers, each key being associated with only one finger, and the electronic circuit being so arranged that one of a plurality of groups of characters is obtained in response to activation of predetermined selector keys, c h a r a c t e r i z e d in that each group of characters corresponds to the characters of one selected row or a selected portion of one selected row of the Sholes keyboard layout, and that the characters within an obtained group of characters are assigned to a group of chord keys on the keyboard.

4. A chorded keyboard according to claim 3, c h a r a c -  
t e r i z e d in that for each of the plurality of groups of  
characters, the pattern of depression of the chord keys has  
the same relationship to the position of the characters in the  
5 relevant row or portion of row of the Sholes keyboard layout.

5. A chorded keyboard according to claim 3 or 4, c h a -  
r a c t e r i z e d in that the comprises two selector keys  
for the little finger, two selector keys for the ring finger,  
two chord keys for each of the middle and index fingers and  
10 four keys comprising shift, space and control keys for the  
thumb.

6. A chorded keyboard according to any of claims 3-5,  
c h a r a c t e r i z e d in the electronic circuit being so  
arranged that a character is transmitted when the number of  
15 activated keys is reduced, provided that the activated keys in  
combination defines the character explicitly.

7. A chorded keyboard according to any of claims 3-6,  
c h a r a c t e r i z e d in the electronic circuit being so  
arranged that a character is transmitted when the number of  
20 activated chord keys is reduced, and in the selection of the  
group of characters being made in dependence of the selector  
keys having been activated once since transmittal of the fore-  
going character, provided that a predetermined time limit has  
not been exceeded and provided that the activated keys in  
25 combination defines the character explicitly.

8. A chorded keyboard according to any of claims 3-7,  
c h a r a c t e r i z e d in the electronic circuit being  
arranged to be put in either of a right hand and a left hand  
mode, one of two subsets of the keys being active in each  
30 mode, whereby the keyboard can be used with either hand of the  
user.

9. A keyboard according to claim 1 or 2, the layout of the  
keys generally corresponding to the layout of the keys on  
either the right hand or the left hand portion of the Sholes  
35 keyboard layout, c h a r a c t e r i z e d in the keys gene-  
rally being assigned a first group of characters laid out in a  
direct relationship to the position of these characters on the  
Sholes keyboard layout, the first group of characters gene-  
rally constituting the characters from one of said portions of  
40 the Sholes keyboard layout, the keys as well being assigned a

second group of characters laid out in a laterally reversed relationship to the position of these characters on the Sholes keyboard layout, the second group of characters generally constituting the characters from the other of said portions, 5 whereby a key for a certain character is positioned to be activated either by the same finger as when touch typing on the Sholes keyboard, or with the corresponding finger on the opposite hand as when touch typing on the Sholes keyboard.

10 10. A keyboard according to claim 9, c h a r a c t e - r i z e d in the keys generally being assigned either the first group or the second of characters, respectively, in response to the activation of a left-right selector key on the keyboard.

15 11. A keyboard according to claim 10, c h a r a c t e - r i z e d in the keys generally being assigned the first or the second group of characters, respectively, in response to the left-right selector key having been activated once since transmittal of the foregoing character.

20 12. A keyboard according to any of claims 9-11, c h a - r a c t e r i z e d in that activation of the left-right selector key assigns the group of characters corresponding to the right hand portion of the Sholes keyboard layout to the keys.

25 13. A keyboard according to any of claims 10-12 and comprising a shift key, c h a r a c t e r i z e d in that on activation of a character key, a character is transmitted in dependency of the shift and left-right selector keys having been activated once since transmittal of the foregoing character, provided that a predetermined time limit has not been 30 exceeded.

14. A keyboard according to any of claims 10-13, c h a - r a c t e r i z e d in that the keys are arranged in a regular, rectangular coordinate grid pattern.

35 15. A keyboard according to any of claims 10-13, c h a - r a c t e r i z e d in that the keys are arranged in a regular, polar coordinate grid pattern.

16. A keyboard according to any of claims 10-13, c h a - r a c t e r i z e d in that the keys are arranged in a regular pattern where the keys in each subsequent row are shifted

laterally approximately one half lateral key spacing with respect to the keys in the preceding row.

17. A keyboard according to any of claims 9-16, c h a -  
r a c t e r i z e d in that the keyboard comprises at least  
5 four rows of keys, the letters and digits from one of the  
first and second group of characters being assigned to keys in  
the four rows in this pattern: 54321; TREWQ; GFDSA; and BVCXZ,  
respectively, and the letters and digits from the other of the  
first and second group of characters being assigned to the  
10 same keys in this pattern: 67890; YUIOP; HJKL; and NM.

18. A keyboard according to any of claims 9-17, c h a -  
r a c t e r i z e d in that the keyboard constitutes a subset  
of keys in a Sholes keyboard, the electronic circuit being  
arranged to put the keyboard in one of at least two of a right  
15 one-hand mode, a left one-hand mode and a normal (Sholes)  
mode, the right-hand portion of the keyboard acting as a key-  
board for right-hand operation in the right-hand mode, and the  
left-hand portion of the keyboard acting as a keyboard for  
left-hand operation in the left-hand mode.

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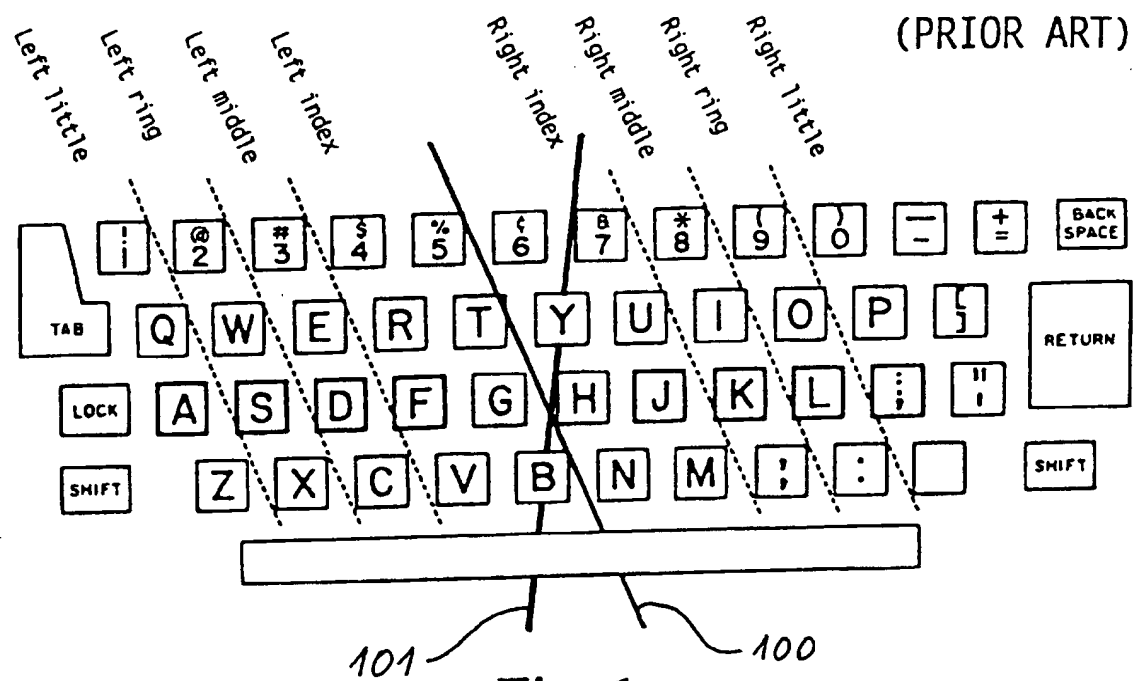


Fig. 1

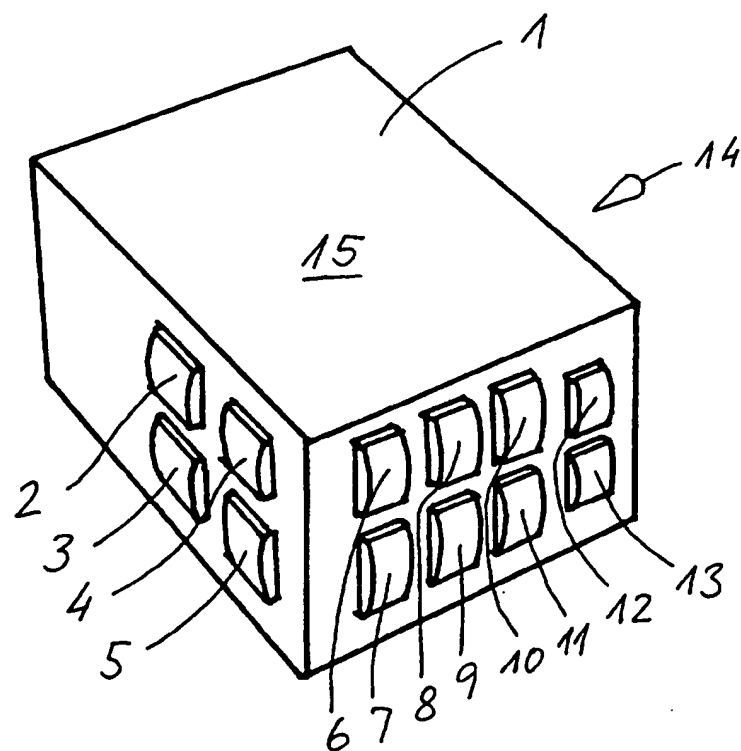


Fig. 2

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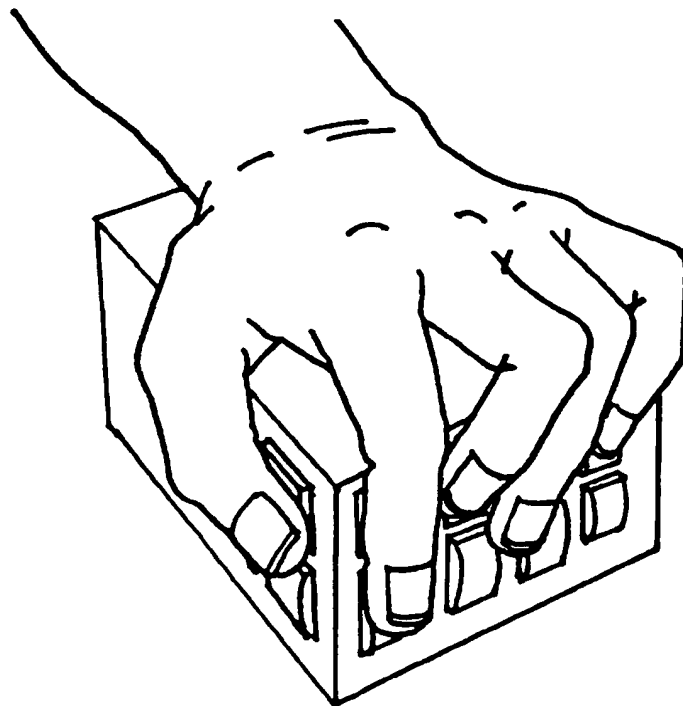


Fig. 3

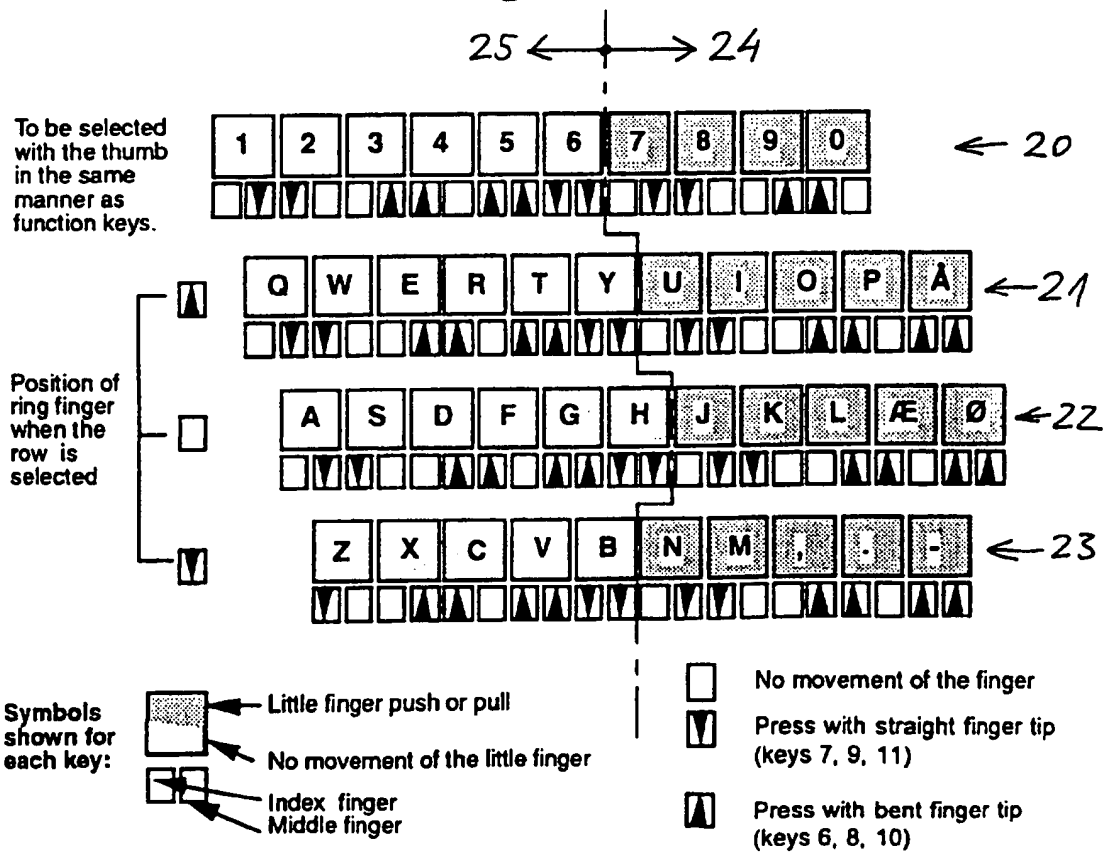


Fig. 4



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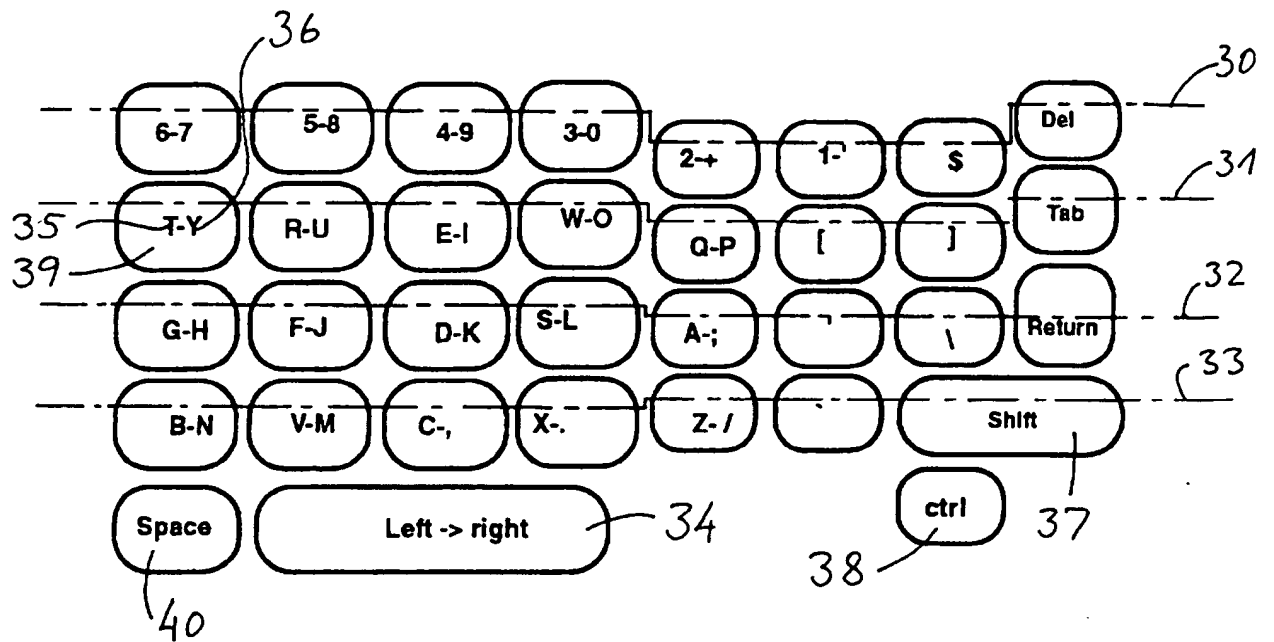


Fig. 5

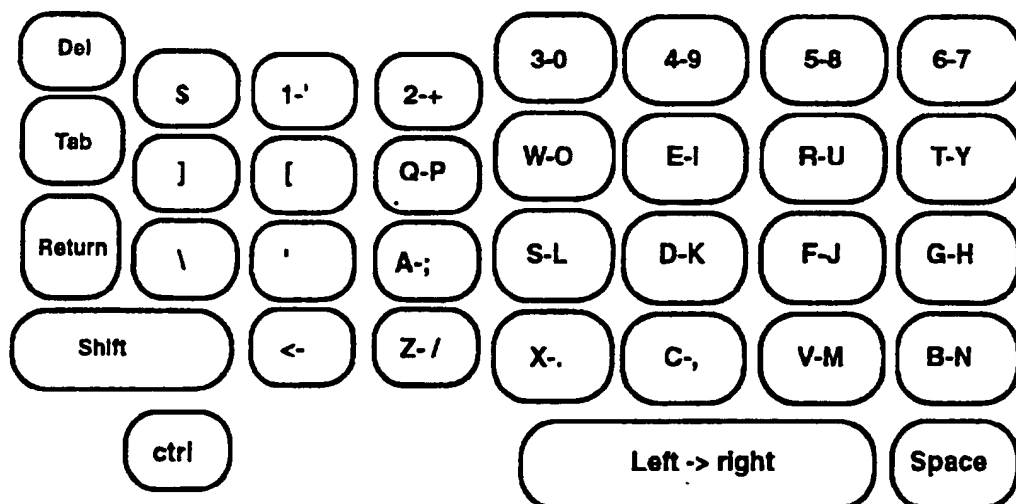
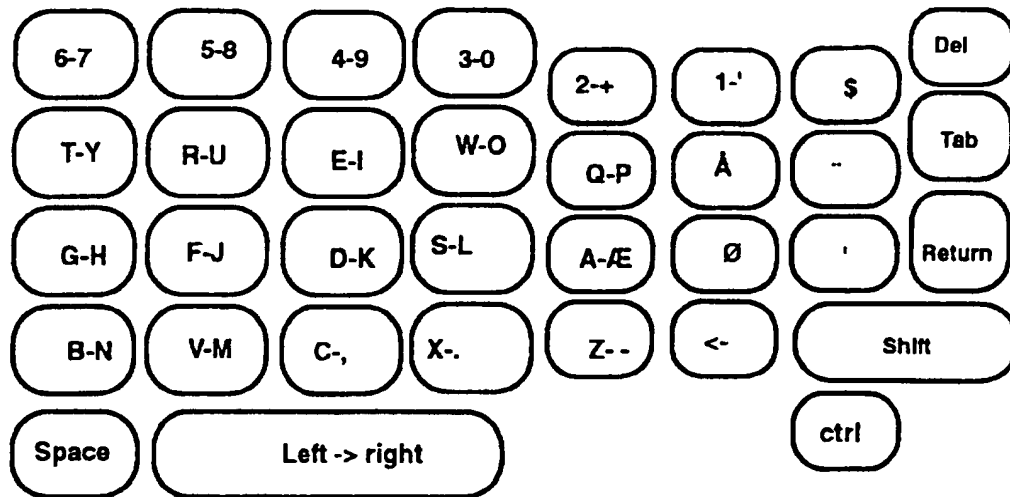
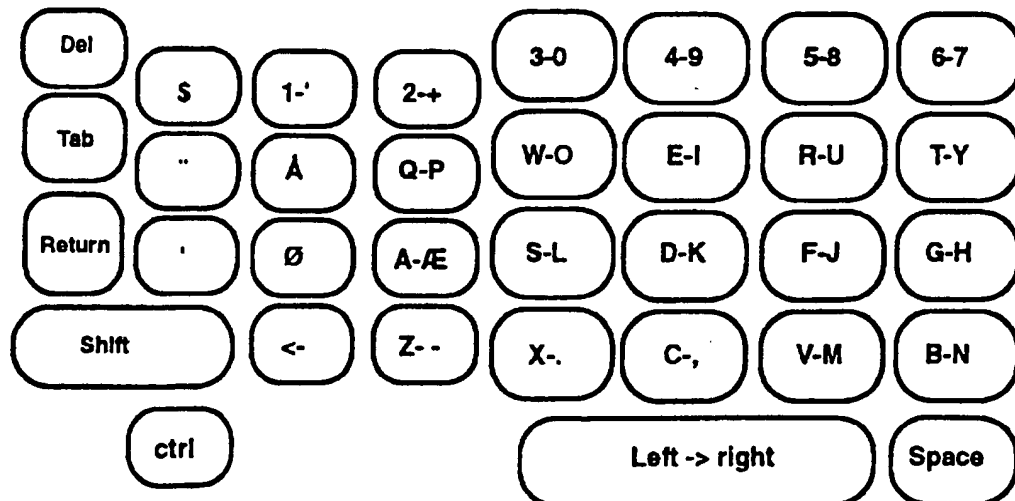


Fig. 6

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*Fig. 7**Fig. 8*

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B41J 5/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9103782 A1 (MATIAS, E.), 21 March 1991 (21.03.91), page 4, line 10 - page 6, line 2, figures 1,2,5 --	1,2,9-18
A	US 4836700 A (P.S. JENSEN), 6 June 1989 (06.06.89), column 3, line 13 - line 37, figures 1,14 --	1-8
A	GB 2131746 A (KAR-KHOON LOKE), 27 June 1984 (27.06.84), page 3, line 12 - line 91, figures 1, 5-7 --	1-8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0217497 A2 (HASHIMOTO, Y.), 8 April 1987 (08.04.87), page 4, line 4 - page 6, line 6, figures 1,2  ---	1-8
A	US 5087910 A (L. GUYOT-SIONNEST), 11 February 1992 (11.02.92), column 5, line 8 - column 6, line 4, figure 1  -- -----	1-8

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

30/10/95

International application No.  
PCT/DK 95/00312

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GB-A- 2131746	27/06/84	NONE	
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